CONSUMER ATTITUDES ON

FOOD IRRADIATION

By

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CONSUMER ATTITUDES ON FOOD IRRADIATION

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Chapter I

INTRODUCTION

In our fast-changing society, technology has brought about many new advances in the foodservice industry. One of the most debated of these advances is food irradiation as a means of preservation. Preservation has always been important in insuring the safety and nutritional value of food. Preservation dates back to the Neolithic period more than 10,000 years ago. People were unaware of why common preservation techniques such as freeze drying, blanching, sterilization, pasturization, cold storage, refrigeration, freezing, canning, chemical additives, and fermentation prevented food from going bad. It was not until quite later that the role of microbes in food spoilage was discovered and that preservation methods were considered of prime importance. Food irradiation is the latest food preservation method today. Food irradiation has the same objectives as other food processing methods. But what is receiving the most attention is the equipment used in the irradiation process, the health and safety requirements that must be taken into account, and numerous other problems that are related to the food that is processed (WHO, 1988).

Food irradiation as a method of preservation is receiving mixed feelings among consumers and food packagers. Despite the advantages of this method of preservation, there are many concerns. Irradiation reduces pathogenic microorganisms and insects on and below the surface of a product without some of the detrimental changes that occur during heat processing. High temperatures used in the heat processing result in the destruction of vitamins; whereas irradiation improves food quality by way of retaining the ordinary characteristics of food. Despite food irradiation advantages there are numerous concerns about this method of preservation among the public (WHO, 1988).

There are many misconceptions about food irradiation which imposes concern among consumers. Some of these misconceptions are that objective and knowledgeable scientists oppose radiation exposed foods, or that you will be forced to eat irradiated food whether you want to or not. A common misconception is that foods that are irradiated are unhealthy or unsafe for human consumption (Katzenstein, 1992). Although the use of irradiation of certain foods and packaging had been endorsed by Food and Drug Administration, United States Department of Agriculture, and Food and Agriculture Organization/World Health Organization, there is still concern by consumers and food processors about the effects of irradiation. These concerns include:

1) How safe are irradiated products, pertaining to chemical composition and cancer?
2) Potential harm of the irradiation plants to the employee's and those who live nearby.
3) Effects of irradiation on taste, quality, and nutritive value of food.
4) Labeling of irradiated foods.(How do consumers know whether the product is rradiated or not?)
5) Cost of irradiated foods.
6) Irradiation will cover-up or disguise bad food.
7) Irradiated foods could become radioactive (Thompson & Facinoli, 1993, pp. 94-95).

These concerns showed that the public is not ready to accept food irradiation as a means of preservation. If the consumer is going to accept this method, education about what irradiation is, and what its effects are on food products needs to be addressed. With this understanding, consumer's can make a better judgment about whether they want to accept food irradiation as a means for preservation.

Besides preservation, food irradiation has many other functional properties. Presently, irradiation is the only method available for inactivating pathogenic microorganisms, such as *salmonella* in frozen products. Food irradiation also inhibits the sprouting of potatoes, onions, yams, and other foods, and allows long-term storage without use of chemical sprout inhibitors. It also causes the death of insects without the use of chemical fumigants, and destroys parasites in food, such as trichinae and tapeworm in pork (Diehl, 1993). Food irradiation can also have a role in reducing world hunger. By extending the shelf life of food products and reducing waste, it can be beneficial in reducing world hunger. As there are benefits in food irradiation as a means of preservation, there are also drawbacks. Like all preservation methods there are aspects of food irradiation that must be considered. At high energy levels, ionizing radiation can make certain constituents of the food radioactive. But below a certain threshold, these reactions do not occur. Carrying out animal studies to determine the safety of food irradiation is costly. Chemical changes that radiation produces in food may lead to noticeable effects on flavor. As with other methods of preservation, some loss of nutrients occur as a result of radiation (WHO, 1988).

Before consumer's are going to accept this method of preservation some questions have to be answered. According to the World Health Organization (1988), these are the questions that need to be answered:

1) What is done to food when it is irradiated?
2) Why is food treated with radiation?
3) Is irradiated food safe to eat?
4) Does irradiation make food radioactive?
5) Do irradiated foods look, smell or taste different?
6) Are irradiated foods still nutritious?
7) Are there long-term effects of eating irradiated foods?
8) Did some animal tests fail to show that food irradiation is safe?
9) What are "radiolytic products"?
10) Have all radiolytic products in food been identified, and are any of them dangerous?
11) Could some of the radiolytic products be damaging cells without our knowing it?

12) What about the microorganisms in food that irradiation does not kill. Are they more dangerous?

13) What foods are treated with radiation?

14) Are irradiated foods on the market now?

15) Who regulates and inspects food irradiation facilities?

16) How can irradiated foods be identified in the market? (pp. 49-53)

Food irradiation has great potential in the food markets across the country. In order for food irradiation to be a successful mean of preservation, these questions and many more need to be made known to the consumer as well as the food packagers and distributors. The key to changes in consumer's attitudes about food irradiation starts with education.

Purposes and Objectives

The purpose of this research was to determine consumer's attitudes regarding the irradiation of food. Specific objectives include:

1) To determine if selected personal variables affect consumer attitudes toward food irradiation.
2) To determine the consumer's breadth of knowledge regarding food irradiation.
3) To determine the relationship between consumer's knowledge and the acceptance of irradiated foods.

Hypotheses

The following hypotheses were proposed.

H_1: There will be no significant association between consumers' knowledge toward food irradiation and selected personal variables, such as age, race, level of education obtained, household yearly income, and size of community where the consumer lives. (Question #9 &10 vs. Questions #1-8, Appendix A)

H_2:There will be no significant association between purchasing patterns regarding irradiated foods and the selected personal variables as listed in Ho1. (Question #11 vs. Questions #1-8, Appendix A)

H_3:There will be no significant association between the purchasing patterns of irradiated food and consumers' knowledge of irradiation.(Question #11 vs. Questions #9 &10, Appendix A)

Assumptions and Limitations

In this study, the researcher assumed that respondents completed the questionnaire objectively. This study is limited to surveying only a random sample (n=600) of members of the Oklahoma Family Community Education Association, therefore results of this study can only be generalized to this group.

Definitions and Terms

Irradiation- Exposure of foods to ionizing radiations from either radionuclide sources or from electron accelerators (Schweigert, 1987).

Radiolytic Products- Chemical compounds formed by exposure to ionizing radiation. Such compounds are formed in food processed by radiation and they are identical or similar to compounds found in food processed by other techniques, such as cooking, or even in unprocessed foods (WHO, 1988).

Oklahoma Family Community Education Association-(OFCEA)- An association open to any individual who pays membership dues and is interested in programs in education, leadership, and community service.

Rad- A dosage of absorbed ionizing radiation equal to absorption of 100 ergs of energy per gram of material (Webster's New World Dictionary, 1994).

Chapter II

REVIEW OF LITERATURE

Food irradiation has recently gained attention among consumers and the food industries. Despite the recent growing concern about what food irradiation is and what it does, food irradiation has been an area of discussion for quite some time. The evolution of food irradiation is quite interesting. The history of food irradiation provides a foundation for why studies are being done at the present time.

Food irradiation dates back to as early as 1905. At that time, scientists received patents for a food preservation process that used ionizing radiation to kill bacteria in food. Strawberries were the first food to be experimented on commercially at the opening of the U.S. radiation facility in 1992 (Thompson & Facinoli, 1993). The irradiation of meat has had quite a history. Beginning in 1921, a U.S. patent was granted for a process to kill *Trichinella spiralis* using X-Rays. In the mid 1900's the Massachusetts Institute of Technology concluded that X-Rays could also be used to preserve ground beef. Later in 1963, FDA and USDA approved irradiation as a means of sterilizing bacon. Just three years later the Army Surgeon General petitioned the FDA and USDA to approve the irradiation of ham, but in 1968 the Army withdrew its petition for approval of the irradiation of ham because the FDA decided that data submitted for irradiation of pork and bacon was not sufficient to prove the safety and wholesomeness of irradiated ham. The FDA and USDA rescinded their approval of irradiated bacon. All these decisions played a large role in the cancellation of plans to build an irradiation facility for meat in Pennsylvania. Due to the foregoings in 1968, the U.S. Army Medical Department awarded a contract to a commercial company to study the wholesomeness of irradiated beef in 1971.

As time went by, the FDA decided to approve irradiation at specific doses for pork to control parasites that cause trichinosis in both swines and humans in 1985. One year later the Food Safety and Inspection Services amended the "Federal Meat Inspection regulation to permit the use of gamma radiation for control of *Trichinella spiralis* in fresh or previously frozen pork" (p. 100). The 1990's showed progress for the irradiation of meats. In 1990, the FDA ruled that irradiation was a safe and effective means of controlling *Salmonella* and other foodborne bacteria in poultry , and in 1992 the USDA proposed irradiation of raw poultry to kill *Salmonella* and other bacteria (Thompson & Facinoli, 1993). The final approval of the irradiation of poultry by FDA came in 1993 (Murray, 1995). Currently USDA has proposed the irradiation of beef, pork, and veal (Nutrition Week, 1994).

As for the irradiation of vegetables, potatoes were the first allowed to be irradiated in the U.S. in 1958. Canada followed in the 1960's by allowing the irradiation of potatoes to take place. Progress was seen in 1964 when FDA approved irradiation to inhibit white potato sprouting. Japan followed the trend and decided to begin commercial production of irradiated potatoes in 1974. In 1986, FDA went one step further and approved the use of specific doses of radiation to delay maturation, to inhibit growth, and to disinfect food which included vegetables and spices (Thompson & Facinoli, 1993). The first irradiation of spices was seen in West Germany in 1957. In 1986, the FDA approved specific doses of radiation that could be used in spices. Wheat and flour were approved by the FDA to be irradiated for insect disinfection in 1963 (Thompson & Facinoli, 1993).

Wholesomeness studies of irradiated food began in the 1920's and has since continued. In the 1950's, President Eisenhower proposed the "Atoms-for-Peace" policy, and as a result formed the National Food Irradiation Program. Under this program, the U.S. Army and Atomic Energy Commission sponsered many research projects on food irradiation. The U.S. Army's Medical Department oversaw a program to study the safety and wholesomeness of 21 foods in the 1960's, and in 1965 the Army Surgeon General concluded from its study of 21 foods, that foods irradiated up to specific doses or energy levels were safe and wholesome. With the numerous studies that were done, the International Atomic Energy Authority (IAEA) decided to publish reports on food irradiation, in which it organized a joint committee with the World Health Organization of the United Nations and the Food and Agriculture Organization of the United Nations. This took place in the 1970's. In 1976, the Joint Expert Committee of the IAEA/WHO/FAO relaxed the testing requirement for irradiated foods, which meant irradiated products were not required to pass tests as was required for food additives. Due to this decision FAO/WHO approved irradiation of eight foods. In 1980, the Army's food irradiation program who was responsible for the studies on the safety and wholesomeness of irradiated foods was transferred to USDA. Progress was seen in 1983, in which the approval from eight foods to any food commodity at specific doses was made (Thompson & Facinoli, 1993). At present, the American Dietetic Association is formulating a position on the food irradiation issue (Murray, 1995). For a more detailed history time-table on food irradiation see Thompson & Facinoli (1993).

Currently, food irradiation has became acceptable in the following foods: potatoes, wheat, beef, pork, chicken, papaya, strawberries, rice, fish, onions, spices, bacon, mushrooms, flour, and milk (Josephson & Peterson, 1982). As far as these foods being readily available or the acceptance of these irradiated foods, there are many drawbacks and concerns. Endorsing irradiation of chicken may suggest that nonirradiated chicken is dangerous. As of 1992, Tyson Foods being one of the 13 major companies, declared that they would not irradiate their chicken. The irradiation of spices has received negative feedback from consumers. Less than 1% of the nation's spices are now irradiated versus 20% to 30% are still treated with ethylene oxide (ETO). The irradiation of produce had not been as successful as forecasted. Irradiation currently treats just a few fruits and vegetables to help keep them from spoiling. Due to irradiation causing spoiling in some fruits and vegetables, it is limited in how beneficial it can be in all produce (Katzenstein, 1992). In discussing the concerns and acceptability of irradiation of foods, advantages and disadvantages are a main factor that needs to be addressed. Among the advantages are its ability to replace chemical treatments. To date, irradiation is the only method available for inactivating pathogenic microorganisms such as *salmonella* in frozen products. Irradiation also has an advantage over chemical fumigation in that it can be applied to the packaged product, avoiding reinfection after treatment. Disadvantages include that milk when irradiated develops a unpleasant taste, and high dose of irradiation can not be given in all foods and so not all microorganisms are destroyed. The highly radiation-resistant spore-forming species, such as *Clostridium botulinium*, can survive radiation. Vitamin losses are also mentioned as a disadvantage of irradiation, however in most cases the losses are not of nutritional significance. One clear disadvantage is that enzymes present in foods are not inactivated, even in high-dose treatments causing radiation-sterilized food to become unacceptable after a few weeks due to enzymatic spoilage. The greatest disadvantage of food irradiation is its name. It evokes such things as high technology, radioactivity, nuclear threats and cancer (Diehl, 1993).

As one begins to try to sort through the complications of this method of preservation, one needs to look to the consumers concerns for guidance. Consumers have the freedom to choose or accept food irradiation or to oppose or reject it. Before looking at consumer's attitudes about food irradiation, the process of irradiation needs to be discussed. Food Irradiation is the process of exposing foods to ionizing radiation, developed either from radionuclide sources (cobalt-60 or cesium-137) or from electrons. The gamma and X-Rays produced by radionuclides and machine sources interact with molecules in food by transferring energy, forming free radicals. These free radicals react with nuclear material of the cell (DNA), and thus prevent microorganisms, parasites, or insects present from reproducing. Some of the effects of the food irradiation process include microbial control, insect deinfestation, extended shelf life, and inhibition of sprouting in certain vegetables (Schweigert, 1987).

The technical basis for legislation on irradiated foods is an important factor to look at. The legal control of food irradiation should be based on the principle of a permitted list of food irradiated under specified conditions. Regulations should include a definition of the item or items of food, specification of the types and energy levels of the radiation that may be used, and statement of the nominal radiation dose to be applied. In order for legislation to be enforced, the production of irradiated foods must be controlled by Licensing and Plant Records. Licensing stipulates that an irradiation plant be operated by qualified personnel in accordance with regulations concerning food irradiation processes. Plant Records must contain operational details of the plant and the period of time the radiation source has been in use. A dosimeter appropriate to the range of radiation to be measured must be chosen in each instance. Biological testing must be used if the irradiation process is used for the elimination of viable microorganisms from food. And lastly, a coded label must be given including the pertinent conditions of a radiation treatment that should be used to assist public health control. Labeling should be provided to inform the consumer that the food has been irradiated and provide instructions on the products handling and storage (FAO & WHO, 1964).

A step toward consumer acceptability is education and consumer awareness about previous food irradiation studies. Educating the public about the food irradiation process and its legislation is one step in consumer acceptability. Making the public aware of studies that have been done on food irradiation is another step toward consumer acceptability. There is a concern among the public about irradiation causing nutritive losses. A study has been done on the thiamin content of fresh pork. It showed insufficient evidence that radiation alone decreased thiamin content (Jenkins,Shayer, & Hansen, 1989). Flavor sensitivity to irradiation of food has also been tested. It was shown to have a slight affect in flavor depending on the dose of radiation (Sudarmardji &

Urbain, 1972). There have also been studies on the effect of irradiation on the volatile oils in black pepper. No change was observed in the volatile oil content with radiation dose or storage time (Piggott & Othman, 1992). The effects of ionizing radiation on plastic food packaging materials has been a concern. The study showed that no toxic substances were extracted from irradiated food packaging. Further studies are needed in this area (Buchalla,Schuttler,& Bogl, 1993). With this background of information concerning food irradiation, consumers can make a decision on whether they want to accept or reject food irradiation as a means of preservation.

To get an idea of what consumers really think or know about food irradiation many studies have been done. In one survey, it was found that the majority of consumers were open-minded and willing to try irradiated merchandise. They looked upon it favorably when told about the benefits it offered. Two-thirds of the people said they would spend 17 cents a pound more for irradiated chicken (Katzenstein,1992). Another survey showed that most of the public are unaware or have little knowledge of food irradiation. Follow-up studies indicated that 20% of consumers oppose the irradiation of foods and were unlikely to change that view. A similar percentage were willing to try irradiated foods on the basis of minimal information. The remainder were open to persuasion in either direction on the basis of information given to them. A factor shaping public opinions has been the location of irradiation plants. There is usually opposition based on fears of the transport of radioactive material to the plant or of possible accidents involving environmental contamination. Market trials showed that most people expressed no objection to the quality of the irradiated product, or that they actually preferred it and would buy it again. General opinions in the market trials indicated that food irradiation would be unlikely to gain wide acceptance until irradiated products were available for sampling. Cost does not seem to be a barrier for buying irradiated foods (Consumers' Association, 1990). A study done at the University of California-Davis, indicated that the younger, female consumers showed a greater resistance to acceptance of irradiated foods than others in the population (Schweigert, 1987). Another study showed that consumers showed a higher level of concern for preservatives and sprays than for food irradiation. Generally, all consumers who have limited knowledge about preservatives, sprays, chemicals, food spoilage, and food irradiation have some concern about food safety. Results of a scientific investigation at the University of California-Davis showed that with more food irradiation education provided, the average consumer had a positive attitude and were willing to buy irradiated food, but became more concerned about sprays, etc. In contrast, the ecologically sensitive consumers did not significantly change their concern for "other" methods, but did significantly have increased concern about food irradiation (Bruhn,Schutz,& Sommer, 1986). Based on these studies and many others, consumers were concerned about the application of radiation to food and the potential adverse affects on health. The average consumer seemed more willing to accept irradiated food if education and awareness were provided.

Industry has some responsibilties to face in the future, as consumers are concerned about the application of radiation to food and the potential adverse affects on health. Food irradiation as a means of preservation, needs to be communicated to the public from the standpoint of its food safety, health issues, and consumer fears.

Food Safety is the main focus of using food irradiation today. In a world where foodborne illnesses are becoming more and more common, food irradiation is one of the answers to this problem. It is the industry's responsibility to market food irradiation via the roles it plays in food safety. For instance, radio or television spots can be used to increase public awareness that irradiation can decontaminate meats and poultry that contain *Salmonella*, thereby increasing the safety of food for human consumption. In addition, inactivation of food-borne parasites, such as *Trichinella* sometimes found in pork, can be secured by irradiation. Irradiation can also be used in insect disinfestation. This is beneficial in that irradiation does not cause problems with toxic residues as does the use of chemical pesticides (Diehl, 1993).

One concern of food irradiation by the public is- "Is it going to affect my health later in life?" Industry must tackle this concern head on with facts intact. The fact of this matter is that worldwide research programs have conducted extensive investigations on the wholesomeness of irradiated foods. The results of this research was that the FAO/IAEA/WHO Joint Expert Committee on Food Irradiation (JECFI) in 1980 concluded that "irradiation of any food commodity up to an overall dose of 10 KGy presents no toxicological hazard" (pp. 31-32). The committee also concluded that this irradiation treatment caused no special nutritional or microbiological problems (WHO, 1981). When given such facts, consumers can have the freedom to choose to purchase irradiated foods or not based on facts, not misconceptions heard elsewhere.

Fears of food irradiation include health issues just addressed, but there are other fears consumers have that the industry must take charge of. Radioactivity is the talk among consumers. The misconception is that food irradiation makes food radioactive or in other terms "food that can glow in the dark." It must be communicated to the public in simple terms. "Food does not become radioactive- no more than having a chest x-ray makes you more radioactive than you are." (Meeker, 1988, p. 66).

It is not just industries responsibility to educate the public about food irradiation. Society also plays a major role in the feelings about food irradiation through myths and misconceptions that may by relayed throughout society. It is society's responsibility, you and I, to clearly address and look at the abundance of myths and misconceptions about food irradiation. If the problem is consumer's concern of lack of any information about food irradiation, then this must also be addressed. To combat both these issues, point-of-purchase educational materials are needed to clear-up the wholesomeness and safety of irradiated products or make people more aware of what food irradiation is and the safety of this process. Another way to reach the public is through public education campaigns on food irradiation. Education focusing on both the advantages and disadvantages of food irradiation is needed, so consumers can make their own informed decisions (Ford &

Rennie, 1987). Providing the information about food irradiation is not enough. Time is needed for consumers to process this information before they can make rational decisions.

Chapter III

METHODOLOGY

This study was designed to assess the attitudes, characteristics and purchasing habits of Oklahoma Family Community Education Association (OFCEA) members towards irradiated food. This chapter will include the research design, population, data collection, which includes instrumentation and procedure, and data analysis.

Research Design

A descriptive status survey was developed for this study. Descriptive studies are a reporting of the characteristics of person, place, and time of a disease or a condition of interest (Monsen, 1992). The instrument was designed to measure the present attitudes of OFCEA members towards food irradiation. There has been no previous exposure of issues concerning food irradiation among this group. The relationship between variables will be the focus of this study.

Population

A stratified sample number (n=600) was taken from the membership list of the Oklahoma Family Community Education Association (N=11,600). This list was obtained from the Cooperative Extension Service office located in the College of Human Environmental Sciences, Oklahoma State University. The sample of 600 was randomly selected from the state of Oklahoma and representative of rural and urban members of the Oklahoma Family Community Education Association.

Data Collection

Instrumentation

A questionnaire was developed to gather information to fulfill the objectives listed in Chapter 1. The questions used were mostly closed form. Section one contains general information about OFCEA members. Section two assesses the awareness and opinions of OFCEA members, as well as their purchasing trends. Section three includes OFCEA member comments about irradiated foods.

Permission to conduct the survey research was obtained from the Institutional Review Board, Oklahoma State University. A pilot study was conducted using 30 consumers belonging to a church group in Glenpool, a suburb of Tulsa, Oklahoma. Content validity, clarity and format of the instrument was examined and approved by graduate students in a foodservice management course and the researcher's committee, who made comments about the questionnaire. Revisions were made prior to the distribution of the instrument.

A cover letter accompanied the questionnaire explaining the purpose and intent of the study. The letter and instrument was printed on green bond paper. A copy of the letter and research instrument may be found in Appendix A.

Procedure

The instruments were mailed on June 10, 1994. A return date by June 24, 1994 was posted on the outside of the instrument. Return postage and Scott Farms complimentary dip mix was included with the instrument to encourage return. A total of 171 usable surveys (29%) were returned. Due to cost and time constraints, only one mailing was done.

Data Analysis

Data were coded for analysis and processed through a computer using the Statistical System Package (SAS, 1991). Frequency tables, Chi-Square Test, t-tests, ANOVA, and Duncan's Multiple Range Tests were used to analyze the data (Freund and Wilson, 1993). The level of significance for all statistical conclusions was established at $p \leq 0.05$.

Chapter IV

RESULTS AND DISCUSSION

The purpose of this study was to determine consumer attitudes regarding the irradiation of food. Data were obtained using the research instrument described in Chapter III, "Methods and Procedures." The questionnaire was mailed to 600 randomly selected members of the Oklahoma Family Community Education Association. The response rate was 29% (N=171).

Characteristics of Survey Participants

Gender and Age

As illustrated in Figure 1, 7 percent (N=12) of the respondents were 35 years of age or younger, 23 percent (N=40) were in the 36 to 55 age group, 28 percent (N= 48) were between 55 to 65 years of age, and 4 percent (N=7) were 65 years or older. Ninety-seven percent (N=166) of the respondents were females, while the remaining three percent (N=5) were males.

Race

The predominant race of the 171 respondents was Caucasian (90 percent, N=152). Seven percent (N=12) of the respondents were Native Americans. The remaining respondents were Black or Hispanics, all under two percent. Two respondents did not give their race (Figure 2).

Key:
1- under 35 years
2- 36-55 years
3- 56-65 years
4- over 65 years

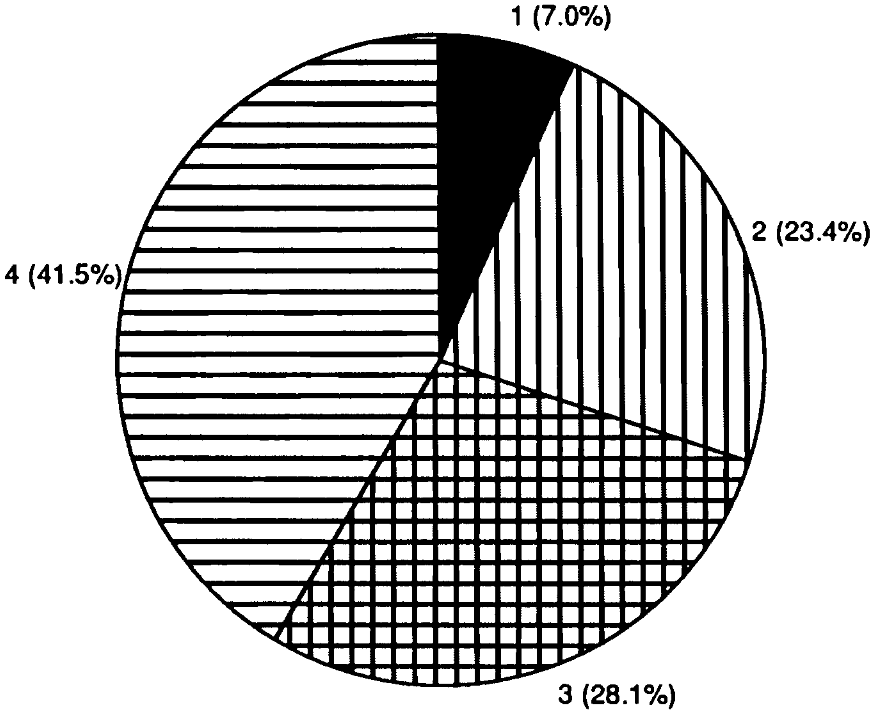

Figure 1. OFCEA Respondents by Age Group

Key:
1- Caucasian
2- African American
3- American Indian
4- Other

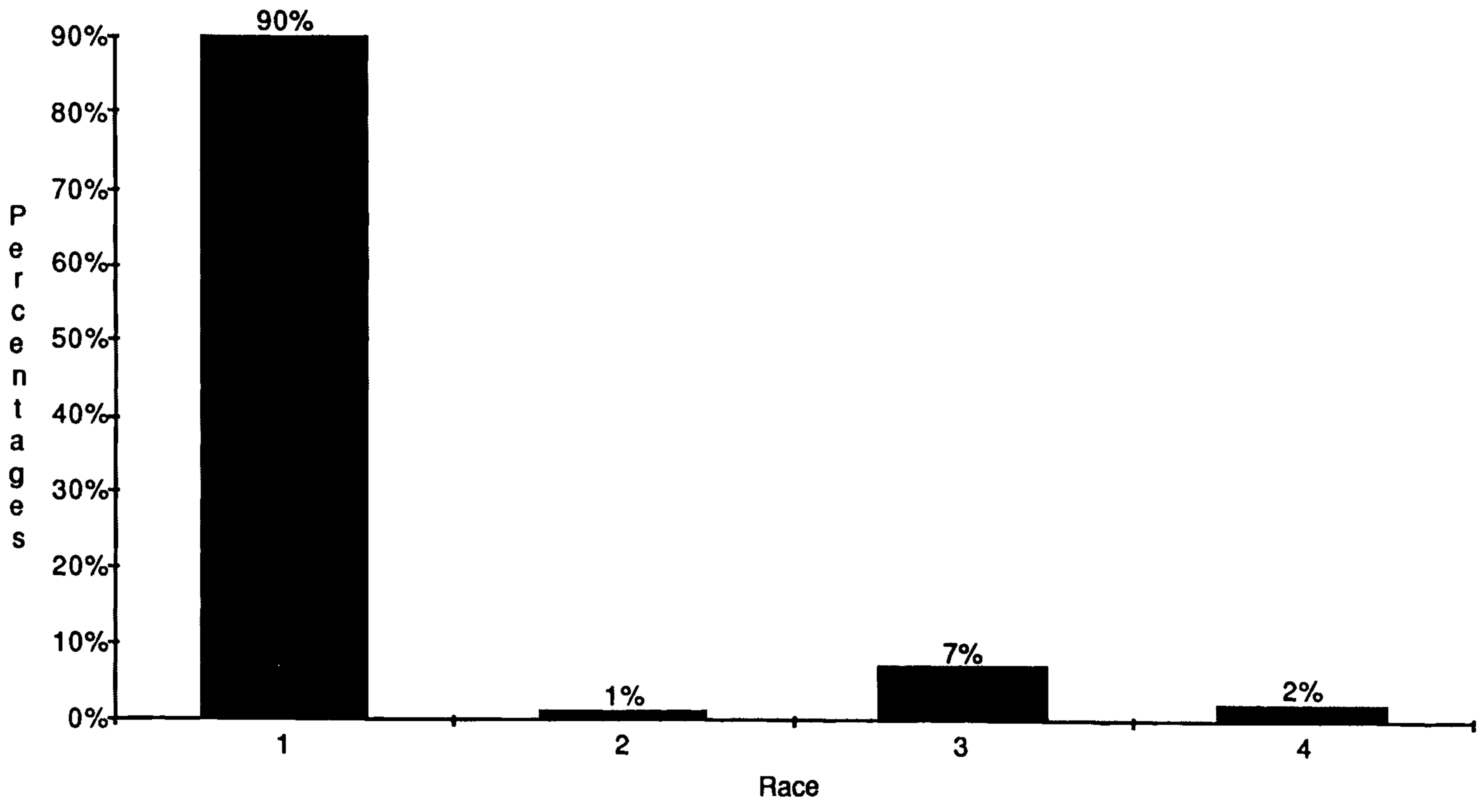

Figure 2. OFCEA Respondents by Race

Household Yearly Income

The majority of the respondents, 66 percent (N=103) earned $35,000 or less. Only 34 percent of respondents (N=53) earned $35,001 or more (Figure 3). Fifteen respondents did not give their household yearly income.

Highest Education Level Attained

As illustrated in Figure 4, there was an equal distribution between those attaining high school or less education (50 percent, N=84) and those attaining some college or more advanced education (51 percent, N=86).

Size of Community

Respondents predominently lived in a community with 4,999 people or less (56 percent, N=94) compared to those residing in communities of 5,000 and larger (45 percent, N=74). Only 7 percent (N=11) resided in large cities of 100,000 and more (Figure 5).

Food Irradiation Knowledge and Where Respondents Obtained Information

Sixty-nine percent (N=110) of the respondents knew what food irradiation was, while 32 percent (N=50) have no knowledge of this process. As illustrated in Figure 6, almost half of the respondents (42 percent, N=72) who knew what food irradiation was obtained their information through news and television. Similiarly, respondents obtained information from friends/family (14 percent, N=24), books (19 percent, N=33), and other sources (17 percent, N=28). Only 4 percent (N=7) of respondents received information through educational endeavors.

Key:
1- ≤ $15,000
2- $15,001-25,000
3- $25,001-35,000
4- $35,001-45,000
5- $45,001-55,000
6- ≥ $55,000

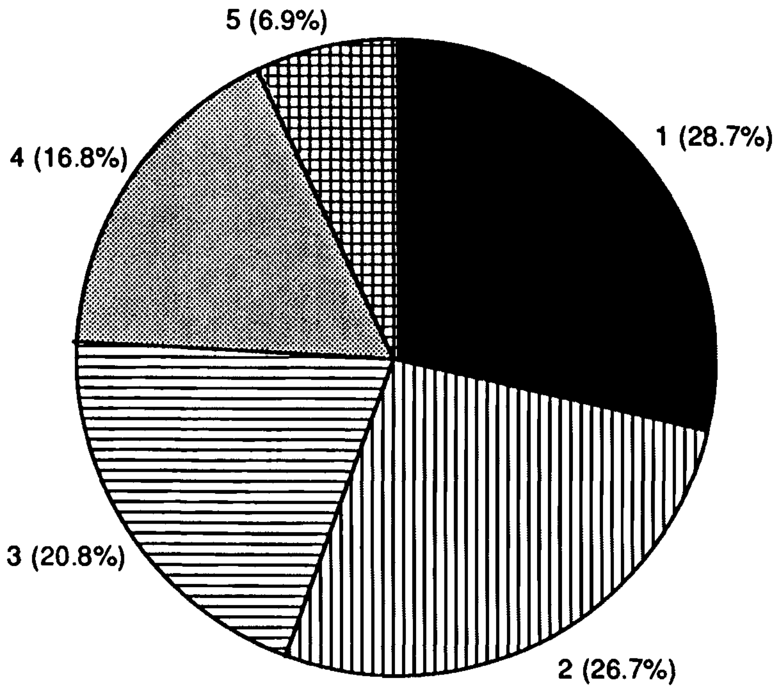

Figure 3. OFCEA Respondents by Income

Key:
1- Less than 12th grade
2- High School Diploma
3- Some College
4- Bachelor's Degree
5- Graduate Degree

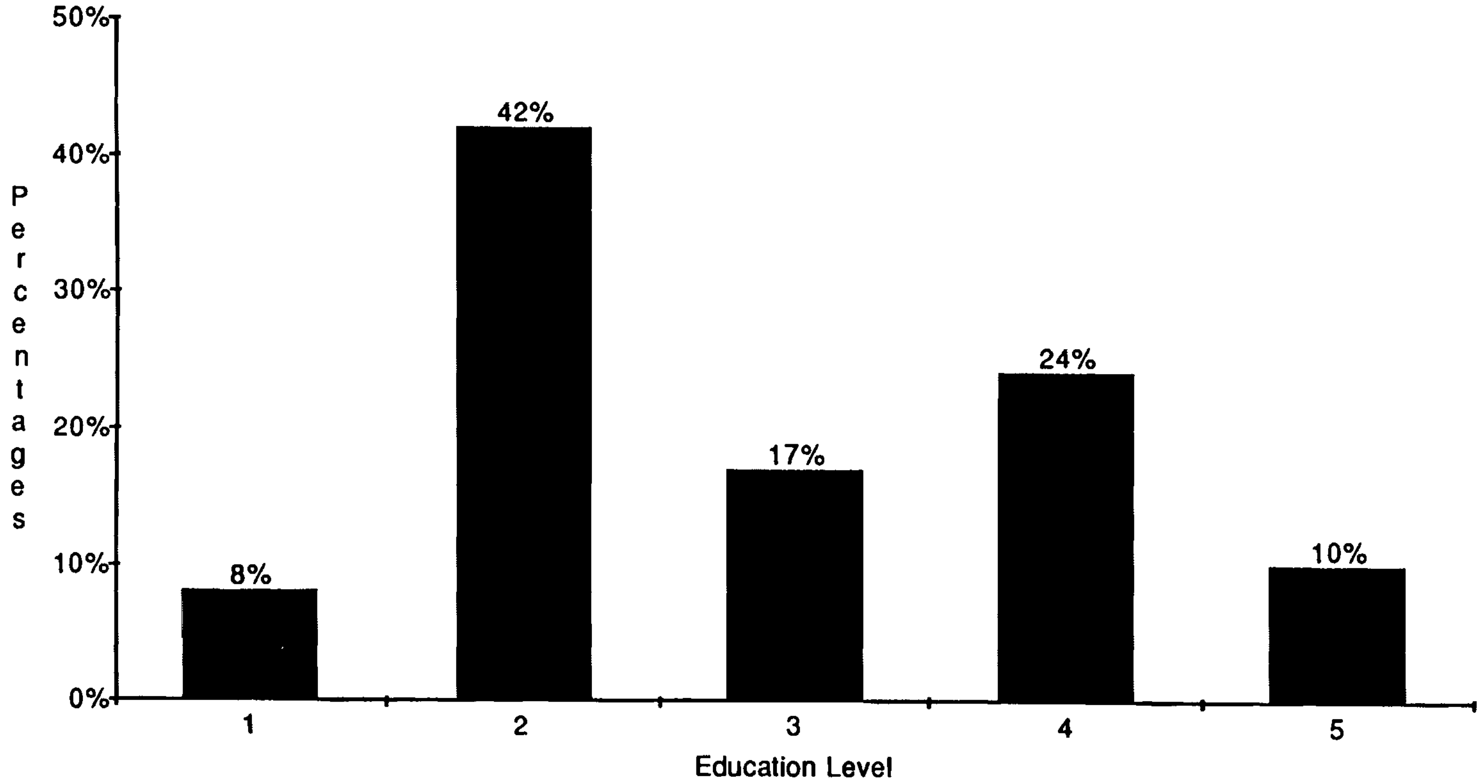

Figure 4. OFCEA Respondents by Highest Educational Level Attained

Key:
1- < 500 people
2- 500-4,999 people
3- 5,000-24,999 people
4- 25,000-99,999 people
5- > 100,000 people

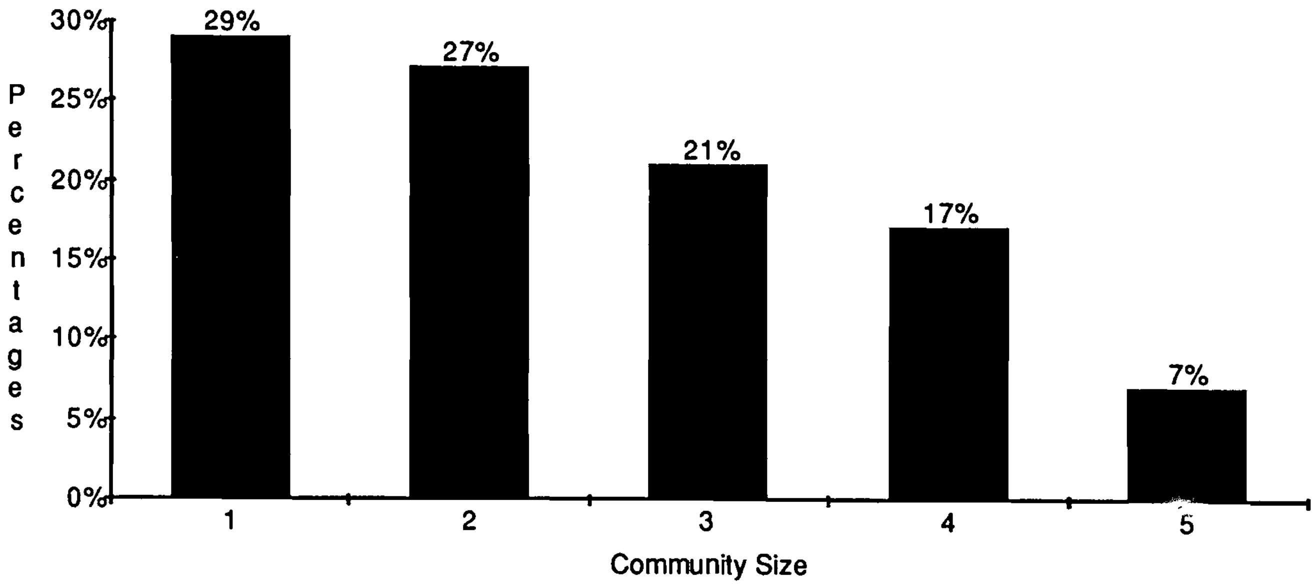

Figure 5. OFCEA Respondents by Community Size

Key:
1- School
2- Friends/Family
3- News/TV
4- Books
5- Other

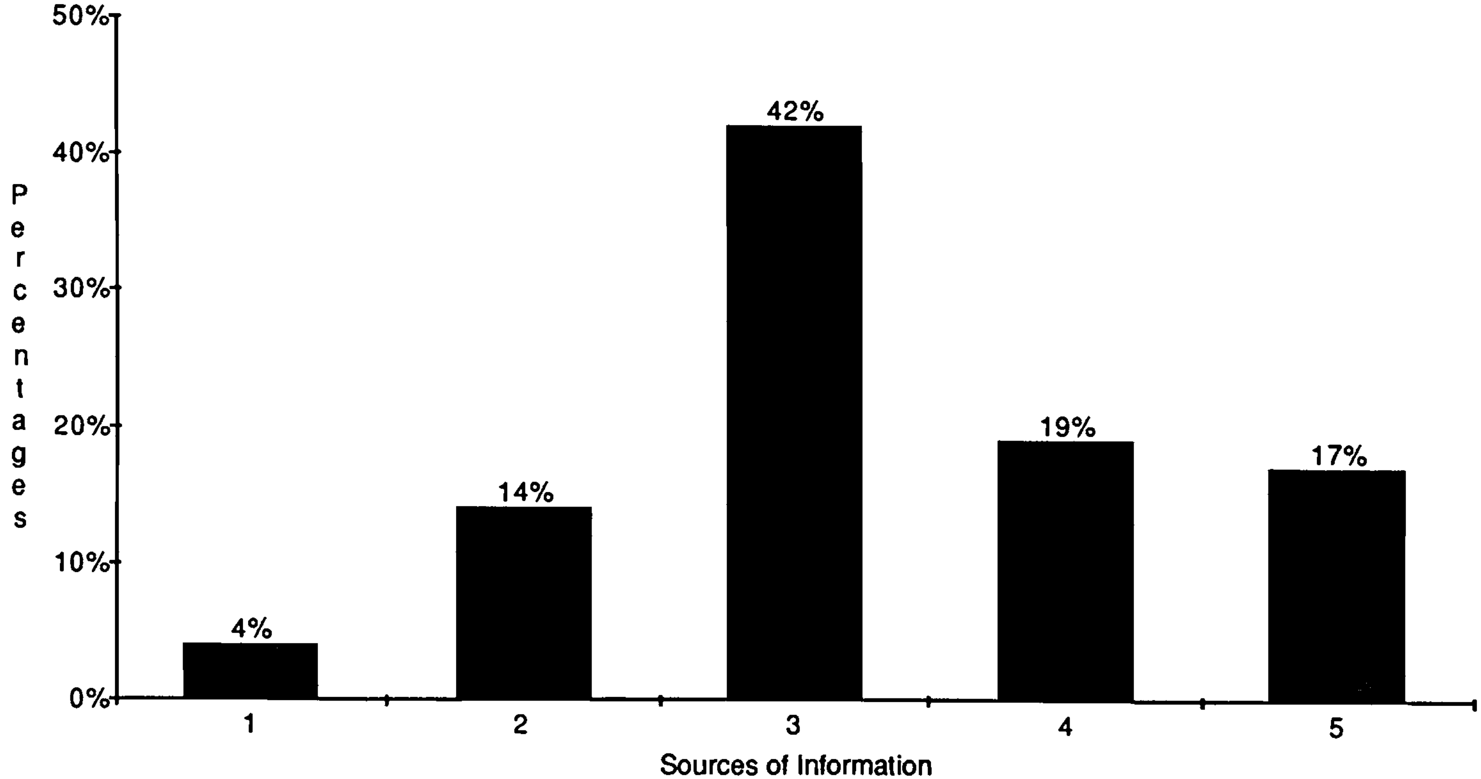

Figure 6. Where Respondents Obtained Food Irradiation Information

Attitudes and Awareness of Food Irradiation

The main purpose of this study was to determine consumer's attitudes and awareness regarding the irradiation of food (Section II-A of the research instrument). Respondents were asked to check the appropriate box that best described their awareness/opinions about food irradiation. The responses available were: Yes, No, and Don't Know.

There were 10 statements describing the awareness/opinions regarding food irradiation (Table I). An average of one-half the respondents answered "Don't Know" to the 10 statements. Food irradiation information is currently limited and not easily available to consumers, hence, these results were as the researcher predicted. About one third of the respondents knew that irradiated foods were available in the market and they were willing to purchase these products.

Chi-square analyses relating consumer's knowledge of food irradiation and the personal variables, race and income were not significant. There were, however, significant associations between consumer's knowledge and their level of education (p=.007) (Table II). There were also significant associations regarding where respondents obtained food irradiation knowledge. Based on the personal variable, education, respondents were more likely to obtain food irradiation information from school, friends/family, and book (p=.002) (Table II). The higher the level of education attained, the more likely the respondents knew about food irradiation. They may have received food irradiation information through lectures, class discussions, reference materials, and information shared by family and friends. Another significant association was between where respondents received food irradiation knowledge and age. Older respondents in this survey were more likely to obtain food irradiation information from "Other" sources (p=.041) (Table II), such as magazines and dictionaries compared with younger consumers who depended upon information from school, friends, family, news/TV, and books. There was a significant association between where respondents obtained food irradiation knowledge and community size (p=.028)(Table II). Consumers residing in communities of less than 5,000 individuals relied more heavily on news/TV for information than any other source, perhaps due to limited access to other avenues. Based on the significant associations between consumer's knowledge of food irradiation and personal variables, age, education, and community size (Table II), the researcher rejected Hypothesis One. There were no significant associations ($p \leq .05$), however, between knowledge and the personal variables, race and income.

TABLE I
AWARENESS AND OPINIONS OF OFCEA MEMBERS
TOWARD FOOD IRRADIATION*

Awareness/Opinion	Yes		No		Don't Know	
	N	%	N	%	N	%
Is irradiation a safe way to lengthen the shelf life of perishable food?	64	39	14	9	85	52
Are irradiated foods harmful to your health	14	9	57	35	92	56
Do irradiated foods contain radioactive materials?	15	9	58	36	89	55
Do you know what radiolytic products are?	23	14	60	37	78	48
Does irradiation make food radioactive?	4	3	67	41	91	56
Do you know what the symbol for foods that have been irradiated look like	15	9	73	45	73	45
Will irradiation change the taste or texture of foods	16	10	56	34	91	56
Will irradiation change the nutritive value of foods?	12	7	60	37	91	56
Are irradiated foods on the market now?	58	36	7	4	96	60
If irradiated foods are available in your supermarket would you purchase them?	51	31	24	15	88	54

* Not all respondents (N=171) replied to each question; the percentages are based on the number of replies to each question.

TABLE II
CHI-SQUARE DETERMINATION INDICATING ASSOCIATIONS BETWEEN KNOWLEDGE OF FOOD IRRADIATION AND PERSONAL VARIABLES

Variable	Knowledge of Food Irradiation	Source of Knowledge		
		School, Books, Friends & Family	News/TV	Other Printed Materials
EDUCATION				
X^2=	10.064	12.042	NS	NS
df=	2	2		
p=	0.007*	0.002*		
COMMUNITY SIZE				
X^2=	NS	NS	7.133	NS
df=			2	
p=			0.028*	
AGE				
X^2=	NS	NS	NS	4.196
df=				1
p=				0.041*
RACE				
X^2=	NS	NS	NS	NS
df=				
p=				
INCOME				
X^2=	NS	NS	NS	NS
df=				
p=				

*$p \leq .05$
NS= Not Significant

Purchasing Patterns of Irradiated Foods

The research instrument was designed to determine consumer's purchasing patterns of irradiated food. The foods were divided into the meat, fruit, vegetable, and miscellaneous group. The meat group consisted of bacon, beef, poultry, pork, and veal. In the fruit group, there was an extensive list of citrus fruits, berries, drupes, and tropical fruits. Vegetables, such as asparagus, mushrooms, onions, potatoes, and tomatoes were among the foods included in the vegetable group. Miscellaneous foods that can be irradiated were listed and included flour, milk and spices. Consumer's were asked to check an appropriate answer; "Yes", "No", or "Don't Know" (Section II-B).

Table III illustrates consumers overall purchasing patterns for groups of irradiated foods. Almost half of the respondents did not know whether they would purchase irradiated foods and the other half either answered "Yes" or "No" to purchasing irradiated foods. This trend may be explained based on some comments by respondents within the questionnaire. Some respondents indicated that, they need more information about the safety of food irradiation and its affects on food products before they can make a decision on whether they would buy irradiated foods or not. In contrast to these comments just mentioned, one-third of respondents would purchase miscellaneous food items, which included flour, milk and spices. Perhaps this is due to the familiarity and history of these foods being the first to be irradiated. Those respondents who answered "No" to the purchasing of irradiated foods may be in part due to the majority of respondents living in rural Oklahoma. In rural Oklahoma, it is traditional for people to raise their own cattle, fruits and vegetables and they may have their own farm or be able to rent garden space to grow these things. They prefer fresh and natural foods versus store bought processed foods with additives, preservatives, or food that has been ultrapasteurized or irradiated.

Purchasing Patterns versus Personal Variables

The t-Tests determination on purchasing patterns of irradiated foods and the personal variable, age, was not significant ($p \leq .05$). There was however, a significant association between purchasing of fruit and race ($p= .0022$) (Table IV). Caucasians versus other ethnic origins were more willing to buy irradiated fruits if available. Another significant association ($p \leq .05$) was between income and the purchasing of meat ($p= .0250$) and fruit ($p= .0080$) (Table V). Those earning more income were more likely to purchase irradiated meat and fruit. Irradiated foods are more expensive than non irradiated foods, thus, those with higher incomes would purchase these foods more so than those with lower earnings.

TABLE III
PURCHASING PATTERNS OF IRRADIATED FOODS

Irradiated Food	Purchasing Pattern*		
	Yes %	No %	Don't Know %
Meat			
bacon, beef, poultry, pork, and veal	26	29	45
Fruits			
grapefruit, nectarines, oranges, tangerines, raspberries, strawberries, apricots, cherries, peaches, plums, apples, melons, pears, bananas, mangoes, papayas, and pineappl	25	22	53
Vegetables			
asparagus, mushrooms, onions, and tomatoes	22	25	48
Miscellaneous			
flour, milk, and spices	31	23	46

* Percentages represent an overall average of single food items within each group listed.

TABLE IV
T-TEST PROCEDURE FOR PURCHASING PATTERNS OF FRUIT AND PERSONAL VARIABLES

Personal Variables	N	Mean	Standard Deviation	t	p-value
Race					
Caucasian	152	22.99	.3939	2.34	0.0022
Other	17	9.69	.1939		

TABLE V
T-TEST PROCEDURE FOR PURCHASING PATTERNS OF MEAT AND FRUIT AND PERSONAL VARIABLES

Personal Variables	N	Mean	Standard Deviation	t	p-value
Income*					
≤ $35,000	118	18.98	.3468		
≥ $35,001	53	33.21	.4471	-2.06	0.0250
Income**					
≤ $35,000	118	15.65	.3305		
≥ $35,001	53	34.18	.4462	-2.71	0.0080

* Purchasing patterns of meat
** Purchasing patterns of fruit

Purchasing patterns of meat were affected by the variable, education level attained. Respondents with a high school or less education significantly (p= .0180) purchased less irradiated meats than consumers with Bachelor's degrees (Tables VI & VII). The higher level of education attained, the more likely consumers would earn more income, thus purchase more expensive foods such as meat. Another reason may be that with advanced education, more respondents may have had access to food irradiation information, which made them more aware of the process and therefore willing to purchase irradiated foods. Significant associations existed between the purchasing patterns of miscellaneous food and education level attained (p= .0163) (Table VIII). Those with graduate degrees were most willing to purchase miscellaneous foods such as flour, milk, and spices. Similiarly, about one-third of respondents with some college or Bachelor's degrees would purchase the products just mentioned, however, less than 20 percent of respondents with high school or less education would purchase these irradiated products (Table IX). It may be suggested as discussed earlier that the higher the level of education attained, the more respondents were able and willing to purchase miscellaneous foods due to higher income and food irradiation knowledge. Purchasing patterns of meat were affected by the variable, community size. Respondents residing in communities less than 5,000 people or communities greater than 25,000 population would significantly (p=.0030) purchase more irradiated meat than those living in communities of 5,000 to 24,999 (Tables X & XI). This may be explained in that those residing in rural communities travel to larger towns or cities to grocery shop, therefore, they want foods that can keep longer, such as irradiated meats. Those consumers living in communities of greater than 25,000 people are open to purchase new and different products as they grocery shop more frequently, thus looking for new foods such as irradiated meats.

TABLE VI
ANALYSIS OF VARIANCE TABLE FOR PURCHASING PATTERNS: MEAT AND EDUCATION LEVEL ATTAINED

Personal Variables	df	Sum of Squares	Mean Square	F-Value	p-value
Education	2	1.177	.5885	4.11	0.0180
Error	167	23.89	.1431		
Corrected Total	169	25.07			

TABLE VII
DUNCAN MULTIPLE RANGE TEST FOR PURCHASING PATTERNS: MEAT AND EDUCATION LEVEL ATTAINED

Personal Variable	N	Mean	Grouping*
Education			
High School or less	84	14.76	B
Associate-Bachelor degree	69	31.59	A
Graduate degree	17	30.59	AB

*Means with the same letter are not significantly different at the .05 level.

TABLE VIII
ANALYSIS OF VARIANCE TABLE FOR PURCHASING PATTERNS: MISCELLANEOUS AND EDUCATION LEVEL ATTAINED

Personal Variable	df	Sum of Squares	Mean Square	F-Value	p-value
Education	2	1.272	.6358	4.22	0.0163
Error	167	25.15	.1506		
Corrected Total	169	26.42			

TABLE IX
DUNCAN MULTIPLE RANGE TEST FOR PURCHASING PATTERNS: MISCELLANEOUS AND EDUCATION LEVEL ATTAINED

Personal Variable	N	Mean	Grouping*
Education			
High School or less	84	17.86	B
Associate-Bachelor degree	69	33.82	AB
Graduate degree	17	39.22	A

* Means with the same letter are not significantly different at the .05 level.

TABLE X
ANALYSIS OF VARIANCE FOR PURCHASING PATTERNS: MEAT AND COMMUNITY SIZE

Personal Variable	df	Sum of Squares	Mean Square	F-Value	p-value
Community Size	2	1.696	.8480	6.01	0.0030
Error	165	23.26	.1410		
Corrected Total	167	24.96			

TABLE XI
DUNCAN MULTIPLE RANGE TEST FOR PURCHASING PATTERNS: MEAT AND COMMUNITY SIZE

Personal Variable	N	Mean	Grouping*
Community Size			
< 5,000 people	194	24.47	A
5,000-24,999 people	35	6.29	B
≥ 25,000 people	39	36.41	A

*Means with the same letter are not significantly different at the .05 level.

The purchasing of fruit was significantly associated with community size (p=.0336) (Table XII). Respondents living in communities with 5,000 to 24,999 people significantly purchased less irradiated fruit than those living in communities of 25,000 people or more (Table XIII). Those in larger communities have greater access to a variety of fruits, thus purchase more fruits. Respondents may have based their answers on whether they purchase fruit or not, not whether they would purchase if irradiated. Purchasing patterns of vegetables were affected by the variable, community size. Consumers living in communities of 25,000 people or more would significantly (p=.0097) purchase more irradiated vegetables than those who lived in communities with 5,000 to 24,999 people (Tables XIV & XV). These results were seen with the purchasing patterns of fruits also. Again, this may be due to the greater access to vegetables that consumers have living in larger communities. The purchasing patterns of fruits and vegetables may also be dependent upon the consumers ability to grow their own fruits and vegetables via gardens in small communities or access to farmer's market versus consumers purchasing from grocery stores in larger towns or cities. There were also significant associations between the purchasing patterns of miscellaneous foods and community size (p=.0211) (Table XVI). Respondents living in communities of less than 5,000 people and greater than 25,000 people would purchase more miscellaneous foods such as flour, milk, and spices (Table XVII). These associations may be explained by consumers residing in small communities travel to larger communities to shop for these items or consumers living in larger communities have easy access to these miscellaneous irradiated products compared to those in medium-size communities. Based on the significant associations between consumer's purchasing patterns of selected irradiated food and the personal variables, race, income, educational level, and community size, the researcher rejected Hypothesis Two. There were no significant associations ($p \leq .05$), however, between the purchasing patterns of meat, fruit, vegetables, and miscellaneous and the personal variable, age. No associations existed between the purchasing patterns of vegetables and miscellaneous food products and the personal variable, income. There were also no significant associations between the purchasing patterns of fruit and vegetables and education level attained. If these purchasing patterns and personal variables were included then, the researcher failed to reject H2.

TABLE XII
ANALYSIS OF VARIANCE TABLE FOR PURCHASING PATTERNS: FRUIT AND COMMUNITY SIZE

Personal Variable	df	Sum of Squares	Mean Square	F-Value	p-value
Community Size	2	.9311	.4655	3.46	0.0336
Error	165	22.17	.1344		
Corrected Total	167	23.10			

TABLE XIII
DUNCAN MULTIPLE RANGE TEST FOR PURCHASING PATTERNS: FRUIT AND COMMUNITY SIZE

Personal Variable	N	Mean	Grouping*
Community Size			
< 5,000 people	94	20.21	AB
5,000-24,999 people	35	9.24	B
≥ 25,000 people	39	31.67	A

*Means with the same letter are not significantly different at the.05 level.

TABLE XIV
ANALYSIS OF VARIANCE TABLE FOR PURCHASING PATTERNS: VEGETABLE AND COMMUNITY SIZE

Personal Variable	df	Sum of Squares	Mean Square	F-Value	p-value
Community Size	2	1.379	.6895	4.77	0.0097
Error	165	23.87	.1446		
Corrected Total	167	25.24			

TABLE XV
DUNCAN MULTIPLE RANGLE TEST FOR PURCHASING PATTERNS: VEGETABLE AND COMMUNITY SIZE

Personal Variable	N	Mean	Grouping*
Community Size			
< 5,000 people	94	22.34	AB
5,000-24,999 people	35	8.57	B
25,000 people	39	35.90	A

*Means with the same letter are not significantly different at the .05 level.

TABLE XVI
ANALYSIS OF VARIANCE TABLE FOR PURCHASING PATTERNS: MISCELLANEOUS AND COMMUNITY SIZE

Personal Variable	df	Sum of Squares	Mean Square	F-Value	p-value
Community Size	2	1.198	.5990	3.95	0.0211
Error	165	25.01	.1516		
Corrected Total	167	26.21			

TABLE XVII
DUNCAN MULTIPLE RANGE TEST FOR PURCHASING PATTERNS:
MISCELLANEOUS AND COMMUNITY SIZE

Personal Variable	N	Mean	Grouping*
Community Size			
< 5,000 people	94	29.08	A
5,000-24,999 people	35	11.43	B
≥ 25,000 people	39	35.90	A

*Means with the same letter are not significantly different at the .05 level.

Purchasing Patterns Vs. Food Irradiation Knowledge

Food irradiation knowledge encompassed whether respondents had knowledge of food irradiation, and if so, where they obtained their knowledge (Section I, question #9&10). The standard statistical procedure used to analyze the data for this portion of the study was the t-test.

When looking at whether respondents knew what food irradiation was, and whether or not they would purchase irradiated foods based on their knowledge or lack of, significant associations ($p \leq .05$) were seen between food irradiation knowledge and the purchase of meat (p=0.0000), fruit (p=0.0000), vegetable (p= 0.0000) and miscellaneous food items (p=0.0000) (Table XVII). Results indicated that consumers who were aware of the safety, function, and availability of irradiated foods would purchase food that had been irradiated, thus, the more food irradiation knowledge consumers had, the more likely they would have a positive attitude towards food irradiation.

There were significant associations ($p \leq .05$) between the purchasing of meat (p=.0425), fruit (p=.0001), vegetable (p=.0002), and miscellaneous food items (p=.0358) and where they obtained food irradiation knowledge (Table XIX). Respondents were more likely to learn about food irradiation through the news/television, or other resources. Trends today include dual-income families relying on immediate access to information via newspapers, magazines, and television. Results support this trend. Therefore, based on the significant associations between purchasing patterns and food irradiation knowledge, the researcher rejected Hypothesis Three.

TABLE XVIII
T-TEST PROCEDURE FOR PURCHASING PATTERNS AND FOOD IRRADIATION KNOWLEDGE

Food Irradiation Knowledge*	N**	Mean	Standard Deviation	t	p-value
Meat	110	31.27	.4149	5.63	0.0000
Fruit	110	29.84	.4280	5.41	0.0000
Vegetable	110	31.09	.4289	4.59	0.0000
Miscellaneous	110	36.67	.4234	6.59	0.0000

* Question 9, (Research instrument, Appendix A).
** Only 110 out of 171 answered Question 9.

TABLE XIX
T-TEST PROCEDURE FOR PURCHASING PATTERNS AND WHERE OBTAINED FOOD IRRADIATION KNOWLEDGE

Where Obtained Food <u>Irradiation Knowledge</u> * News/TV or Other	N**	Mean	Standard Deviation	t	p-value
Meat	88	32.73	.4115	3.38	0.0425
Fruit	88	1.22	.4312	3.66	0.0001
Vegetable	88	34.09	.4386	4.11	0.0002
Miscellaneous	88	36.36	.4217	164.3	0.0358

*Question 10 (Research instrument, Appendix A).
**Only 88 out of 171 responded to Question 10.

CHAPTER V

SUMMARY, RECOMMENDATIONS AND IMPLICATIONS

Summary of Results

Respondents were predominantly female (97%), 55 years or older (70%), white (90%), earning $35,000 or less annually (66%), and residing in communities of 500 to 25,000 population (77%). Only 39 percent of the respondents knew that food irradiation increased shelf life, one-third were aware of the availability of irradiated foods and would purchase irradiated meats, fruits, vegetables, and miscellaneous food items, and about 10 percent knew about radioactivity, safety, and the changes in nutritive value, texture, and taste of irradiated foods.

Personal variables, education, community size, and age had significant associations between knowledge of food irradiation and where respondents obtained their knowledge. The higher the level of education attained, the more likely respondents knew about food irradiation and received this knowledge through school, books, family and friends. Consumers residing in communities of less than 5,000 individuals relied on news/television for food irradiation knowledge. Older respondents in this survey were more likely to obtain food irradiation knowledge from "Other" sources, such as magazines and dictionaries (Table XX).

There were significant associations between race, education, income, residence, and purchasing trends. More Caucasians would purchase irradiated fruits than African Americans, Hispanics, and Native Americans. Those with Bachelor's or higher degrees would purchase meats and miscellaneous foods such as milk, flour and spices more than respondents with high school or less education. Respondents earning more than $35,000 would purchase more meats and fruits than those earning less than $35,000. Consumers

TABLE XX
SUMMARY OF ASSOCIATIONS BETWEEN KNOWLEDGE OF FOOD IRRADIATION AND PERSONAL VARIABLES (H_1)

Variable	Food Irradiation Knowledge	Source of Knowledge		
Materials		School, Books, Friends & Family	News/TV	Other Printed
Education	p=0.007*	p=0.002*	NS	NS
Community Size	NS	NS	p=0.028*	NS
Age	NS	NS	p=0.041*	

*p≤ .05

TABLE XXI
SUMMARY OF ASSOCIATIONS BETWEEN PURCHASING PATTERNS AND PERSONAL VARIABLES (H_2)

	Race*	Education*	Income*	Community Size*
Meat**	NS	p=0.0180	p=0.0250	p=0.0030
Fruit**	p=0.0022	NS	p=0.0080	p=0.0336
Vegetable**	NS	NS	NS	p=0.0097
Miscellaneous**	NS	p=0.0163	NS	p=0.0211

*Personal Variables
**Purchasing Patterns

TABLE XXII
SUMMARY OF ASSOCIATIONS BETWEEN PURCHASING PATTERNS AND KNOWLEDGE OF FOOD IRRADIATION (H_3)

Purchasing Pattern	Food Irradiation Knowledge *	Source of Knowledge** News/TV/Other Printed Materials
Meat	p=0.0000	p=0.0425
Fruit	p=0.0000	p=0.0001
Vegetable	p=0.0000	p=0.0002
Miscellaneous	p=0.0000	p=0.0358

*Question 9 (Research instrument, Appendix A).
** Question 10 (Research instrument, Appendix A).

living in communities of less than 5,000 and greater than 25,000 individuals would purchase more irradiated foods than those residing in communities between 5,000 to less than 25,000 population (Table XXI). Those respondents who were aware of food irradiation and obtained food irradiation knowledge from news/television and other printed materials would purchase irradiated meats, fruits, vegetables, and miscellaneous food items (Table XXII).

Recommendations

The research instrument could include more closed-ended questions regarding the knowledge and purchasing habits of consumers to receive a more precise perception of these factors. A follow-up procedure such as, sending reminder postcards or a second mailing of the instruments would elicit a higher response rate than the 29 percent received in this study. A random sample of all households in the U.S. needs to be surveyed to provide additional insights regarding a more accurate assessment of the attitudes of consumers regarding food irradiation nationwide.

Implications

Based on past studies, this study supported findings, in which the more education and awareness provided to consumers, the more consumers were willing to purchase irradiated foods. With this in mind, dietitians, home economists and nutrition educators at all levels need to develop education materials that focus on irradiation's effect on the shelf life, safety, nutritive value, texture and taste of foods. These materials need to be made available to consumers at point-of-purchase and included as resource materials at County Extension offices. Education about food irradiation should extend to high school, middle school, and elementary schools, where it can be included in science, home economics, and health classes to increase awareness about the safety and benefits of food irradiation. Education through print/radio/television is needed to reach all consumers, especially those residing in medium size communities. Since a wide variety of food items are irradiated and are now available from various food outlets, consumer education and marketing/advertising efforts should be available nationwide via print/radio/television. One area that could be included in education materials is that irradiation improves the color, flavor, taste, and shelf life of various fruits and vegetables.

Five servings of fruits and vegetables is recommended by health professionals to promote good health (Hardy, 1994). To promote the 5-A-Day concept, consumers need to be encouraged to eat a variety of fruits and vegetables in various forms, such as juices, dried, canned, frozen, and irradiated fruits and vegetables. In addition, efforts should be made to promote food irradiation through food demonstrations in supermarkets and farmers markets. Food samples could be available at these food demonstrations or coupons for irradiated foods mailed to all households or test market states. A professional or a person knowledgeable about food irradiation should be available to answer consumer's questions and concerns about the benefits and safety of food irradiation. An avenue to reach consumers and answer their questions and concerns may be through an 1- 800-number made available for governmental agencies, such as USDA or FDA, through television, county extension offices, or the National Center for Nutrition and Dietetics, American Dietetic Association in Chicago.

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APPENDIXES

APPENDIX A

CORRESPONDENCE
AND
RESEARCH INSTRUMENT

OKLAHOMA STATE UNIVERSITY
Department of Nutritional Sciences
College of Human Environmental Sciences

June 10, 1994

Dear Consumer,

CONGRATULATIONS! You have been selected as one of the 600 members of the Oklahoma Association for Family and Community Education(OAFCE) to participate in a very important study entitled "Consumers' Attitudes toward Food Irradiation." The OAFCE officers have approved this study. Recently there has been considerable interest and concern about consumers attitudes regarding food irradiation. The attached questionnaire focuses on your awareness/opinions, and purchasing of irradiated foods. We would appreciate it if you would take 10 minutes of your time to complete the questionnaire.

Once the questionnaire is completed, fold it in thirds and staple it closed. The return address should be visible after stapling. Return it on or before June 24, 1994.

In appreciation for your participation in this project, a Scott Farms dip mix is enclosed. Your response will be extremely important to the outcome of this study. Survey instrument is not coded and no names will be solicited from the participants. Data will be summarized without mention of names, therefore there will be complete confidentiality relative to respondents. Results of this survey will be shared with Dr. Donna Cadwalader and your association.. If you have any questions, please call us at (405)-744-8294. We look forward to hearing from you soon.

Sincerely,

(Signed)

Michelle Goss
Graduate Student

(Signed)
Lea L. Ebro, Ph.D., R.D.
Major Advisor

FOOD IRRADIATION SURVEY

I. GENERAL INFORMATION:

Direction: Please check the appropriate information about yourself.

1) What is your gender? ☐ Male ☐ Female

2) What is your age? ☐ Under 35 ☐ 36-55 ☐ 55-65 ☐ 65 or older

3) Which of the following best describes your racial or ethnic identification?

☐ Caucasian ☐ African American ☐ American Indian ☐ Other____________

4) What is your occupation?__________________________

5) What is your household yearly income?

☐ Below $15,000 ☐ $35,001-45,000

☐ $15,001-25,000 ☐$45,001-55,000

☐ $25,001-35,000 ☐$55,001 or above

6) What is your highest educational level?

☐Less than 12th grade ☐ Bachelor's degree

☐ High School diploma ☐ Graduate degree

☐ Other____________________

7) Are you the main food purchaser of your household? ☐ Yes ☐ No

8) In which size community do you live?

☐ Under 500 ☐ 500 to 4,999

☐ 5,000 to 24,999 ☐ 25,000 to 99,999 ☐ Over 100,000

9) Do you know what irradiation is? ☐ Yes ☐ No

If yes, where did you obtain the information (check all that apply).

☐ School ☐ Friends & Family ☐ News/TV ☐ Book ☐ Other_________

Turn over ➔

II. FOOD IRRADIATION SURVEY

A) AWARENESS/OPINIONS

Directions: Please check the appropriate box that **BEST** describes your **AWARENESS/OPINIONS** about food irradiation.

	Yes	**No**	**Don't Know**
1) Is irradiation a safe way to lengthen the shelf life of perishable food?			
2) Are irradiated foods harmful to your health?			
3) Do irradiated foods contain radioactive materials?			
4) Do you know what radiolytic products are?			
5) Does irradiation make food radioactive?			
6) Do you know what the symbol for foods that have been irradiated looks like?			
7) Will irradiation change the taste or texture of foods?			
8) Will irradiation change the nutritive value of food?			
9) Are irradiated foods on the market now?			
10) If irradiated foods are available in your supermarket would you purchase them?			

B) PURCHASING

11) Which of these foods (listed below) would you purchase if irradiated:

	Yes	**No**	**Don't Know**
MEAT			
Bacon			
Beef			
Poultry			
Pork			
Veal			

PURCHASING CONTINUED:

	Yes	No	Don't Know
FRUITS			
Grapefruits			
Nectarines			
Oranges			
Tangerines			
Raspberries			
Strawberries			
Apricots			
Cherries			
Peaches			
Plums			
Apples			
Melons			
Pears			
Bananas			
Mangoes			
Papayas			
Pineapple			
VEGETABLES			
Asparagus			
Mushrooms			
Onions			
Potatoes			
Tomatoes			
MISCELLANEOUS			
Flour			
Milk			
Spices			

III. GENERAL COMMENTS ABOUT IRRADIATED FOODS:

____

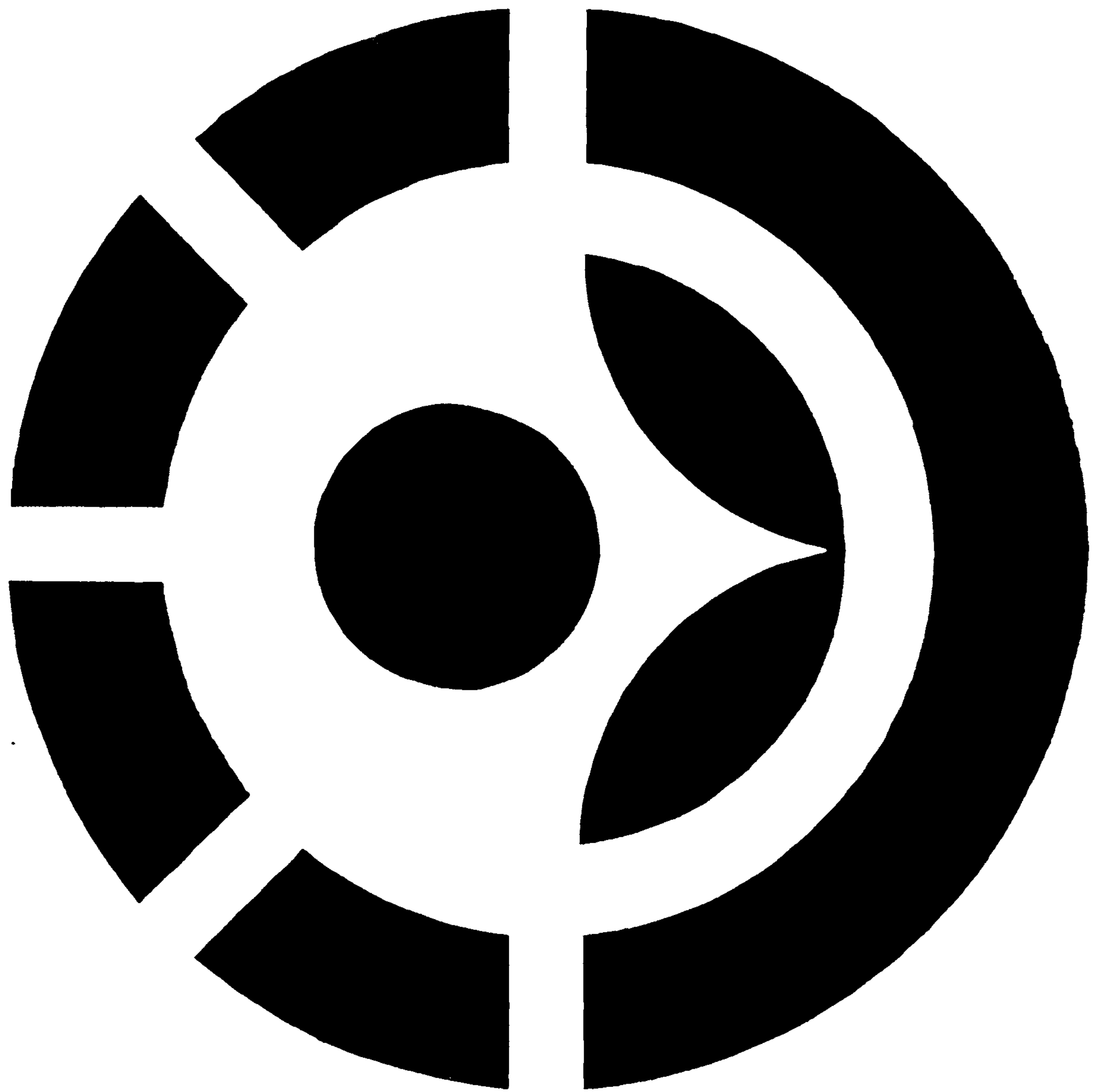
____

____

THANK YOU FOR YOUR VOLUNTARY PARTICIPATION.

APPENDIX B

FOOD IRRADIATION SYMBOL



APPENDIX C

CHI-SQUARE TABLES

TABLE OF EDUC BY Q9

FREQUENCY	YES	NO	TOTAL
PERCENT			
H.S. OR LESS	44	33	77
	27.5	20.62	48.13
ASSOC.-B.S. DEGREE	51	15	66
	31.87	9.38	41.25
GRADUATE DEGREE	15	2	17
	9.38	1.25	10.63
TOTAL	110	50	160
FREQUENCY MISSING	11		
STAT FOR TABLE OF EDUC BY Q9			
STATISTIC	DF	VALUE	PROB
CHI-SQUARE	2	10.064	0.007

Q9=KNOWLEDGE OF FOOD IRRADIATION

TABLE OF COM_SIZE BY WHERE3

FREQUENCY	YES	NO	TOTAL
PERCENT			
5,000 AND UNDER	40	53	93
	23.95	31.74	55.69
5,000-24,999	9	26	35
	5.39	15.57	20.96
25,000 AND OVER	22	17	39
	13.17	10.18	23.35
TOTAL	71	96	167
FREQUENCY MISSING=4			
STAT FOR TABLE OF COM_SIZE BY WHERE3			
STATISTIC	DF	VALUE	PROB
CHI-SQUARE	2	7.133	0.028

WHERE3=NEWS/TV

TABLE OF EDUC BY WHERE124

FREQUENCY	YES	NO	TOTAL
PERCENT			
H.S. OR LESS	19	65	84
	11.18	38.24	49.41
ASSOC.-B.S.DEGREE	24	45	69
	14.12	26.47	40.59
GRADUATE DEGREE	11	6	17
	6.47	3.53	10
TOTAL	54	116	170
FREQUENCY MISSING=1			
STAT FOR TABLE OF EDUC BY WHERE124			
STATISTIC	DF	VALUE	PROB
CHI-SQUARE	2	12.042	0.002

WHERE124=SCHOOL, FRIENDS/FAMILY,BOOKS

TABLE OF AGE BY WHERE5

FREQUENCY	YES	NO	TOTAL
PERCENT			
55 AND YOUNGER	4	48	52
	2.35	28.24	30.59
56 AND OLDER	24	94	118
	14.12	55.29	69.41
TOTAL	28	142	170
FREQUENCY MISSING=1			
STAT FOR TABLE OF AGE BY WHERE5			
STATISTIC	DF	VALUE	PROB
CHI-SQUARE	1	4.196	0.041

WHERE5=OTHER PRINTED MATERIAL

VITA

Denise Michelle Goss

Candidate for the Degree of

Master of Science

Thesis: CONSUMER ATTITUDES ON FOOD IRRADIATION

Major Field: Nutritional Sciences

Biographical:

Personal Data: Born in Stillwater, Oklahoma, December 2, 1970, the daughter of Larry L. and JoAnna Scott; married Dean Curtis Goss in 1992.

Education: Attended Western Oklahoma State College, received Associate of Science Degree in May 1991; received Bachelor of Science Degree in December, 1993 at Oklahoma State University; completed an Approved Pre-Professional Practice Program at Oklahoma State University in May, 1995; completed requirements for the Master of Science degree at Oklahoma State University in July, 1995.

Professional Experience: Marketing Assistant, Scott Farms Gourmet Wholesale Food Co., January, 1985 to May, 1989; Product Specialist, Scott Farms, June, 1989 to August, 1991; Nutrition Aide, Stillwater Medical Center, January, 1992 to July 1994; Marketing Specialist, Scott Farms, January, 1995 to present.

Professional Honors: 1995 Oklahoma Dietetic Association Outstanding AP4 Student; Kappa Omicron Nu Member, 1995; Phi Kappa Phi Nominee, 1994; Who's Who Among College Students, 1993; National Dean's List, 1992, Oklahoma State University Alumni Association Outstanding Student Award, 1993-94.

Professional Organizations: American Dietetic Association; Oklahoma Dietetic Association.

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
FOR HUMAN SUBJECTS RESEARCH

Date: 12-14-93 **IRB#:** HES-94-017

Proposal Title: CONSUMER ATTITUDES ON FOOD IRRADIATION

Principal Investigator(s): Lea Ebro, Christine Sumner, Michelle Goss

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

APPROVAL STATUS SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING.
APPROVAL STATUS PERIOD VALID FOR ONE CALENDAR YEAR AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL. ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Reasons for Deferral or Disapproval are as follows:

Signature: John H. Wyckoff Date: December 15, 1993

Chair of Institutional Review Board